An Account of ſome OBSERVATIONS *made with a view to aſcertain whether* MAGNIFYING POWER *or* APERTURE *contributes moſt to the diſcerning ſmall Stars in the Day. By the Rev.* HENRY USSHER, *D. D. M. R. I. A. and F. R. S.*

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IT has long been a diſputed point amongſt aſtronomers, nor is it, I believe, yet decided, whether aperture or magnifying power contributes moſt to the diſcerning ſmall ſtars in the day.

THE following experiments and obſervations, made with the tranſit inſtrument of our obſervatory, may perhaps tend to throw ſome light on the ſubject: they were made with care, and are certainly related without prejudice, for the concluſion I arrive at, is contrary to what I ſuppoſed previous to experiment.

THE tranſit inſtrument of the obſervatory is furniſhed with three different ſyſtems of eye-glaſſes, making the magnifying powers of the inſtrument about 200, 400 and 600. Theſe ſyſtems being conſtructed by Mr. Ramſden upon the principle indicated

indicated by him in a paper publiſhed in the Tranſactions of the Royal Society, may be changed at pleaſure, without diſturbing the line of collimation, or altering the quantity of the celeſtial ſpaces, ſubtended by the intervals of the wires; this inſtrument, therefore, ſeems very proper for the purpoſe.

I SHALL ſet down the obſervations juſt as I made them, although the firſt ſet is not concluſive, as they compare magnified areas with lineal apertures.

THE diameter of the object-glaſs is $4\frac{3}{10}$ inches. I made three diaphragms of paſteboard, with apertures whoſe diameters were inverſely proportional to the ſquare roots of the magnifying powers; and by means of theſe I could compare ſeverally 600 and 200, 400 and 200, and 600 and 400; although, as remarked above, theſe compariſons are not exactly juſt.

THINGS being in readineſs, I began my experiments on December 2d; and in theſe I did not depend ſolely on my own eye; I thought it better to put them to the teſt of eyes leſs uſed to aſtronomical obſervation, yet ſufficiently acquainted with the practice, to find ſmall ſtars in the field of view.

θ BOOTIS of the fourth magnitude paſſed 2H. 12′ before the ſun: this ſtar was viſible with 200, but incomparably better with 600 with the diminiſhed aperture; it appeared with a planetary roundneſs. This trial was made by me.

β URSÆ

β URSÆ minoris, to an unpracticed eye, appeared confeſſedly better with 600 than 200

SECOND γ Urſæ minoris paſſed 1 H. 7′ before the ſun. The ſame eye gave the ſame concluſion.

γ SERPENTIS 3d magnitude paſſed 52′ before the ſun: not viſible to me with 200 and whole aperture; ſeen with 600, and the proportional diminution of aperture; and ſhewn to another perſon; ſought for again with 200, but in vain *.

θ and η DRACONIS, both of 3—4 magnitude; the latter paſſed 12′ 32″ before the ſun; viſible with both powers, but far better with 600 to an eye that had ſome practice, and alſo to me.

DECEMBER 4, ſecond γ Urſæ minoris, not diſcoverable with 200, plainly ſeen with 600 by an eye totally unuſed to obſervation.

δ DRACONIS, not viſible to the ſame with 200, ſeen plainly with 600; afterwards diſcovered with 200, but with difficulty.

N. B. THIS day was a little hazy, with thin clouds, through which both by night and day the 600 had the advantage, and ſhewed to my eye many ſtars that were inviſible with 200. I mention this, becauſe I at firſt ſuſpected, that although the great power had the advantage in the clear blue ſky of December 2d,

* This ſtar was very near the ſun, and its being viſible is a ſtrong proof of the excellence of this inſtrument

yet

yet perhaps it might be inferior in another ſtate of the air, by magnifying the haze and vapors; but the obſervation of γ Serpentis in the glare of the ſun on the 2d, and many ſtars both by night and day on the 4th, confirm the ſuperiority of 600.

I NEXT prepared a ſet of diaphragms whoſe areas of aperture were inverſely proportional to the magnified area of the object.

DECEMBER 12th, β Urſæ minoris diſtinct and magnified with 600; diſtinct alſo but not magnified with 200: this ſtar is too bright for any concluſion to be drawn.

1ſt γ Urſæ minoris, a very ſmall ſtar, viſible with 600, with its proportional aperture; inviſible with 400.

MANY other trials proved the ſuperiority of the great magnifying power with diminiſhed aperture: I cannot omit mentioning one more.

DECEMBER 29th, β Lyræ paſſed 7' after the ſun; this ſtar, of the 3d magnitude, and ſo near the ſun, I had little expectation of ſeeing. I ſought it in vain with 200 and 400, but ſaw it plainly and obſerved its paſſage with 600, having an aperture rather ſmaller than juſt proportion demanded. I ſhewed the ſtar to another perſon before it quitted the field of view.

FOR the ſuperiority of magnifying power the following cauſes may be aſſigned:

THE

THE principal one, perhaps, is the quickneſs of the ſtar's motion in the field of view. That this contributes to perception I collect from hence; that when a ſtar, although within the field, does not immediately preſent itſelf to the eye, as is ſometimes the caſe with Jupiter near the ſun, if the teleſcope be gently moved, the apparent motion of the ſtar immediately diſcovers its place.

ANOTHER reaſon may perhaps be the magnified image of the ſtar which thus becomes a more perceptible object, even though its light is diminiſhed; this amplification, as far as I can perceive, is nearly in the inverſe proportion of the aperture; in very conſiderable diminutions at leaſt, it ſeems to follow this proportion: thus with an aperture $\frac{3}{10}$ of an inch the polar ſtar took 64" to paſs the wire: with one of $\frac{6}{10}$ 32",5: but with $\frac{9}{10}$ 30", and with 2,8 inches 19".

I AT firſt ſuſpected that this amplification aroſe from ſome unavoidable error in the object-glaſs, which created a circle of diſſipation around the principal image, which circle became viſible in proportion to the darkneſs of the field; but by the following experiment it ſeems to ariſe from the inflexion of light. I made a rectangular aperture $\frac{3}{10}$ of an inch broad, and $\frac{6}{10}$ long; when this aperture was applied vertically, it gave me an elliptical horizontal image; and when applied horizontally, it gave me an elliptical vertical image. Alſo when I applied a triangular aperture, it gave an image nearly the ſhape of a pear; the broad end being formed by the vertex, and the narrow end by the baſe: the triangle was formed with a long baſe and ſmall altitude, ſo

that the effect of the other angles on the image became inſenſible to the eye.

I SHALL conclude with pointing out an advantage that I reap from this circumſtance: By means of a conſiderable diminution of aperture, I make the polar ſtar ſo diſtinctly round and large, that I obſerve the appulſe of its limbs to each edge of the wires, as well as the paſſage of its centre over them; by which means much greater preciſion is obtained in proving either the collimation or meridian.